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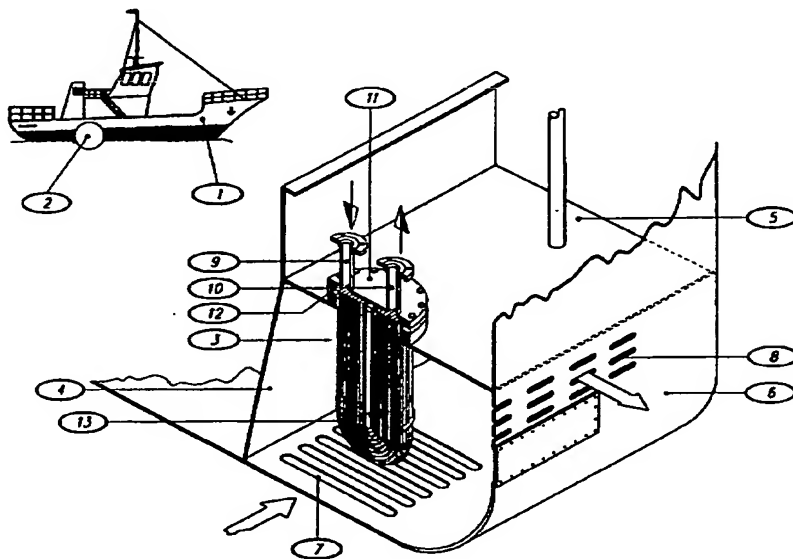
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- (71) Applicant (for all designated States except US): BLOKSMA B.V. [NL/NL]; Draaibrugweg 15, NL-1332 AB Almere (NL).
- (72) Inventor; and
- (75) Inventor/Applicant (for US only): BLOKSMA, Walter [NL/NL]; Rozenwerf 64, NL-1355 AE Almere (NL).
- (74) Agent: VAN BREDA, Jacques; Octrooibureau Los en Stijger B.V., Weteringschans 96, NL-1017 XS Amsterdam (NL).
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(54) Title: COOLING APPARATUS



(57) **Abstract:** The disclosure relates to a cooling apparatus (3) for the cooling water of a marine engine, comprising cooling pipes (13) through which the cooling water is conducted, a pipe plate (12) on which the cooling pipes (13) are mounted, and a water header (11) at the side of the pipe plate (12) facing away from the cooling pipes (13), which water header (11) has connecting stubs (9, 10) for inlet and outlet of the cooling water, wherein the pipe plate (12) is made of plastic.

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Cooling apparatus

The invention relates to a cooling apparatus suitable for cooling water, for example, the cooling water of a marine engine, comprising cooling pipes through which the cooling water is conducted, a pipe plate on which the cooling pipes are mounted, and a water header at the side of the pipe plate facing away from the cooling pipes, which water header has connecting stubs for inlet and outlet of the cooling water.

Such a cooling apparatus has already been in existence for 40 years. A cooling apparatus is a heat exchanger used on sea-going ships that have 5 to 10 megawatt-powered marine engines. Such ships have a length of between 30 and 150 metres. As a rule the cooling apparatus is used for cooling the cooling water of the marine engines. Of course, the cooling apparatus can also be employed for cooling water from another source. For the purpose of cooling, heat exchange takes place between the cooling fluid in the cooling apparatus of the marine engine and the surrounding seawater. The cooling apparatus is mounted in a cavity in a special watertight space behind the ship's hull. The ship's hull is provided with inlet and outlet openings to allow the seawater access to the cooling apparatus. The pipe plate plays an important role in the cooling apparatus. Said pipe plate has a number of functions, such as

- separating the cooling water and the seawater and absorbing the inherent pressure difference;
- leak-proof fixing of the cooling pipes;
- carrying mechanical stresses on the cooling pipes and transferring these stresses to the ship's hull;
- positioning the cooling pipes (subject to the chosen manufacturing process);
- distributing the flow of the cooling fluid in the water header;

- stabilizing vibrations in the pipe coil.

The cooling apparatus as such and its parts such as the pipe plate, have to comply with strict requirements. The desired mechanical life of the cooling apparatus is 20 years and this also applies to the pipe plate. This mechanical life corresponds with that of the ship in which the cooling apparatus is installed. Consequently the cooling apparatus is sold as a maintenance-free product. This means that the occurrence of unforeseen maintenance is not permitted, whereas customary planned maintenance may take place. This takes place when the ship is docked.

The cooling apparatus and the pipe plate have an important safety function. As mentioned above, the cooling apparatus is located behind a cavity in the ship's hull. This means that the cooling apparatus must be leak-proof at all times, including under conditions of fire and in the presence of corrosive liquids and gases.

One can imagine that the pipe plate of the cooling apparatus is subjected to considerable stress. The pipe plate has to be able to withstand all thermomechanical stresses; short-term (stationery, blow, impact, vibrations), long-term (creep, stress relaxation), thermal stresses and thermal shock. The thermal limits are determined, among other things, by thermal safety measures applied to the marine engine itself.

Due to the extensive requirements the cooling apparatus and the component pipe plate have to meet, the known cooling apparatus is a costly product. The cost price of the known cooler (price level 1999) is from about NLG 2,500 for the smallest model to NLG 40,000 for the larger models.

With all these technical requirements, the fact that the known cooling apparatus and its integral parts such as cooling pipes, pipe plate and water header, are made of metal, is a problem. In the prior art the cooling pipes and pipe plate are substantially made of a copper alloy. This results in the problem that the mounted cool-

ing apparatus causes corrosion problems due to contact potentials.

It is the chief objective of the invention to eliminate this corrosion problem and at the same time to
5 provide a cooling apparatus that can be manufactured at lower costs, while continuing to comply with all the requirements with which the cooling apparatus is confronted in practice.

In order to serve these purposes, applicant has
10 broken with the many decennias-old practice, and the pressure from insurance companies to manufacture the cooling apparatus for safety reasons entirely of metal, and has discovered after a prolonged and costly period of development, that the aims of the invention may be realized with
15 a cooling apparatus whose pipe plate is made of plastic.

Desirably the plastic has a load-bearing capacity of up to 6 bars overpressure at a temperature ranging from -20°C to +100°C. In this way the load requirements occurring in practice can be met, while in addition the
20 load-bearing capacity of the plastic pipe plate is maintained during the entire mechanical life of the cooling apparatus.

In a further advantageous embodiment variation of the cooling apparatus according to the invention, the
25 pipe plate and the water header form a whole. The cost price of the cooling apparatus embodied with the plastic pipe plate is already reduced by approximately 20-30%. This cost price may be further reduced by means of the measure just mentioned.

30 It is further advantageous to embody the cooling apparatus such that the same is provided with a substantially copper-comprising element which, when the cooler is installed in a ship, can be adjusted to an anodic potential. This is a very simple and effective manner of protecting the cooling apparatus against fouling problems,
35 caused by the growth of organisms.

The invention will now be explained with reference to the drawing of a single Figure 1. Figure 1, shows

as silhouette a ship 1, and in detail a cross section of a cooling apparatus mounted in the ship. It is a ship of the type discussed above, namely with a length between 30 and 150 metres and provided with a 5 to 10 megawatt-powered engine. In the ship's side, approximately in the circle 2, a cooling apparatus 3 is installed. Said cooling apparatus 3 is mounted in a space behind the ship's hull 6, made water-tight by means of partition plates 4 and 5. Via the openings 7 and 8, the space delimited by the partition plates 4 and 5 and the ship's hull 6, is freely accessible to seawater. The cooling apparatus 3 has connection stumps 9 and 10 for the supply or discharge of cooling water to the marine engine (not shown). Said connection stumps 9 and 10 form part of a water header 11, which is in communication with a pipe plate 12. On the said pipe plate 12 the cooling pipes 13 are mounted, through which flows the cooling water of the marine engine, supplied and discharged via the connection stumps 9 and 10. The pipe plate 12 is made of plastic, which preferably has a load-bearing capacity of up to 6 bars in a temperature range from -20°C to +100°C. Due to its plastic embodiment, said pipe plate 12 provides a galvanic separation between the ship 1 on one hand and the coil of cooling pipes 13 on the other hand, thereby safeguarding said cooling pipes against corrosion problems.

In an advantageous embodiment variation which will be clear to the person skilled in the art without requiring any further explanation, the pipe plate 12 and the water header 11 are designed such as to form a whole. Also not shown but completely clear to the person skilled in the art, is a favourable embodiment variation in which the cooling apparatus 3 is provided with a substantially copper-comprising element which, when the cooling apparatus 3 is installed in a ship, can be adjusted to an anodic potential. This latter feature effectively combats fouling of the cooling apparatus, thereby ensuring that a high level of cooling power is maintained.

CLAIMS

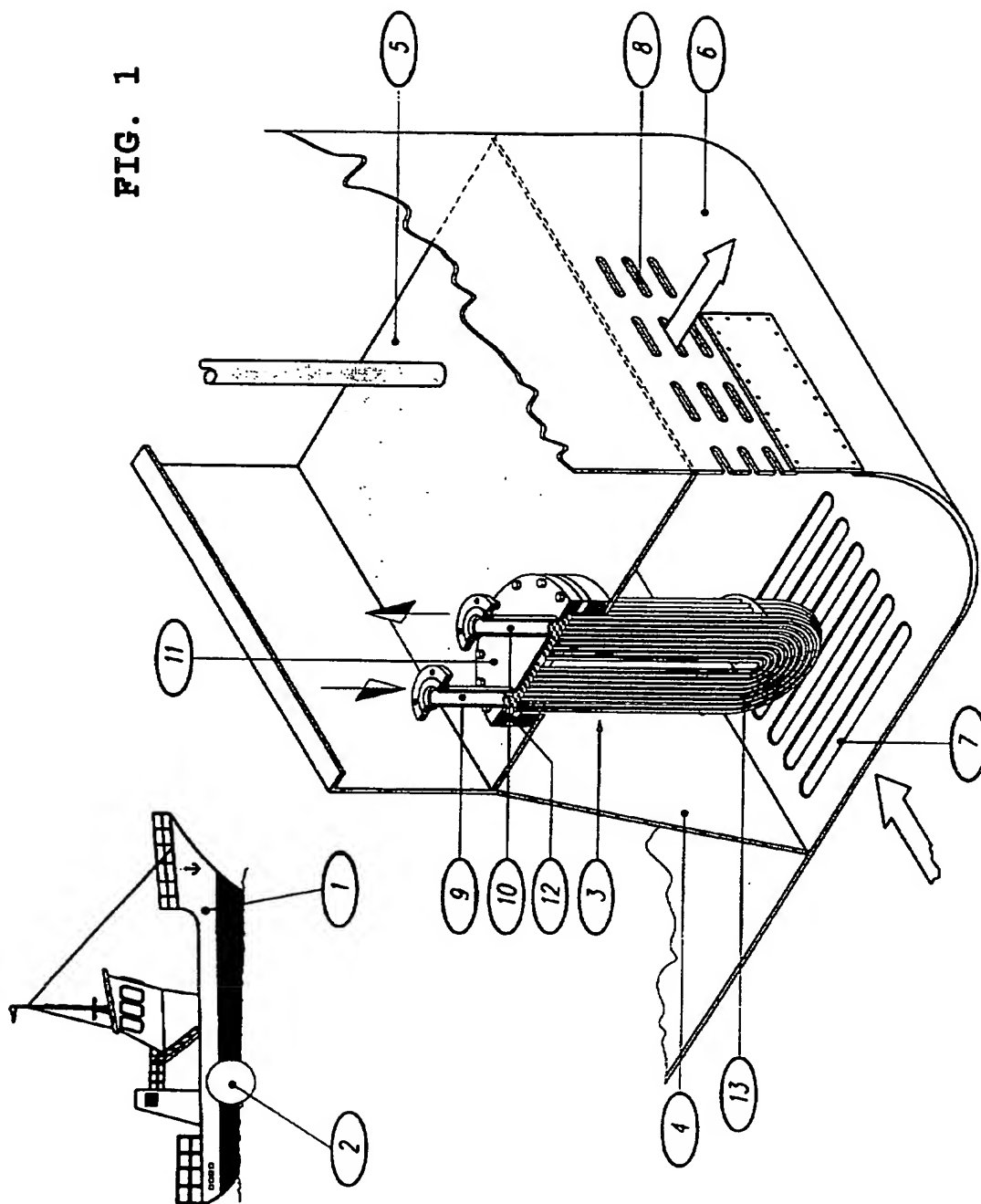
5 1. A cooling apparatus (3) for the cooling water
of a marine engine, comprising cooling pipes (13) through
which the cooling water is conducted, a pipe plate (12) on
which the cooling pipes (13) are mounted, and a water
header (11) at the side of the pipe plate (12) facing away
10 from the cooling pipes (13), which water header (11) has
connecting stubs (9, 10) for inlet and outlet of the cool-
ing water, **characterized** in that the pipe plate (12) is
made of plastic.

 2. A cooling apparatus according to claim 1, **char-**
15 **acterized** in that the plastic has a load-bearing capacity
of up to 6 bars overpressure at a temperature ranging from
-20°C to +100°C.

 3. A cooling apparatus according to claim 1 or 2,
characterized in that the pipe plate (12) and the water
20 header (11) form a whole.

 4. A cooling apparatus according to one of the
preceding claims, **characterized** in that the same is pro-
vided with a substantially copper-comprising element
which, when the cooler (3) is installed in a ship (1), can
25 be adjusted to an anodic potential.

FIG. 1



INTERNATIONAL SEARCH REPORT

International Application No.

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A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B63H21/38 F01P3/20 //F28F21/06, B63H21/14, B63B13/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B63H F01P B63J B63B F28F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

WPI Data, EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	BEER JOACHIM: "Außenhautkühlung eine bevorzugte Kühlungsart für Binnenschiffe" SCHIFF UND HAFEN., vol. 27, no. 7, July 1975 (1975-07), pages 555-557, XP002138909 SEEHAFEN-VERLAG ERIK BLUMENFELD. HAMBURG., DE ISSN: 0938-1643 figure 4 page 556, middle column, line 27 -right-hand column, line 10	1,2
Y	WO 94 15163 A (CESARONI ANTHONY JOSEPH) 7 July 1994 (1994-07-07) page 7, line 4 -page 9, line 22 --- -/--	1,2

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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- *&* document member of the same patent family

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Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax (+31-70) 340-3016

Authorized officer

Häusler, F.U.

INTERNATIONAL SEARCH REPORT

International Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 19 11 766 A (MACY JAMES B JUN ET AL) 9 October 1969 (1969-10-09) claim 15; figures 1,2 page 6, line 25 -page 8, line 12 -----	1
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

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